TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Total Mercury in Fish Tissue Residue

In the

Etowah River (HUC 03150104)
Including Listed Segment

Clear Creek to Forsyth County Line (Dawson County, GA)

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In the Etowah River Watershed

Under the authority of Section 303(d) of the Clean Water Act, 33 U.S.C. 1251 et seq., as amended by the Water Quality Act of 1987, P.L. 100-4, the U.S. Environmental Protection Agency is hereby establishing a TMDL for total mercury for the protection of public health associated with the consumption of fish taken from the following segment of the Etowah River in Georgia:

Clear Creek to Forsyth County Line

The calculated allowable load of mercury that may come into the identified segment of the Etowah River without exceeding the applicable water quality standard is 0.5 kilograms per year. The applicable water quality standard is the State of Georgia's numeric interpretation of their narrative water quality standard for protection of human health from toxic substances. This interpretation provides that total mercury in the Etowah shall not exceed the level that will result in bioaccumulation of more than 0.3 mg/kg mercury in fish tissue residue.

1. Introduction

The U.S. Environmental Protection Agency (EPA) Region 4 is proposing this Total Maximum Daily Load (TMDL) for total mercury for one listed segment of the Etowah River, Georgia from the confluence of Clear Creek to the Forsyth County Line. This segment was included on the State of Georgia's 2002 Section 303(d) list of impaired waters because mercury in fish tissue exceeded the numeric interpretation of the Georgia narrative water quality standard of 0.3 mg mercury/kg fish tissue (GAEPD, 2001).

The State of Georgia provided EPA with a numeric interpretation of the Georgia narrative water quality standard for mercury (GADNR-EPD, 2001). The numeric interpretation, which provides that methylmercury in fish tissue is not to exceed 0.3 mg/kg, is consistent with EPA's recently adopted guidance value for methylmercury (USEPA, 2000; USEPA, 2001). The State also provided EPA with a methodology for determining when a waterbody is impaired and is to be listed on the State's Section 303(d) lists, as well as a methodology for calculating the site-specific allowable water column concentration to protect the general population from the accumulation of mercury in fish tissue. Using EPA's recently collected site-specific data for mercury and the State's methodology for calculating allowable mercury concentrations, this listed segment of the Etowah River is attaining the applicable water quality standard for mercury. However, the Consent Decree in the case of Sierra Club v. EPA, 1:94-cv-2501-MHS (N.D. Ga.) requires the State or EPA to develop TMDLs for all waterbodies on the State of Georgia's current 303(d) list. Although the listed segment of the Etowah River appears to be attaining the applicable water quality standard for mercury, EPA is proposing this TMDL because the listed segment remains on the State's current 303(d) list.

TMDLs are required for waters on a state's Section 303(d) list by Section 303(d) of the Clean Water Act (CWA) and the associated regulations at 40 CFR Part 130. A TMDL establishes the maximum amount of a pollutant a waterbody can assimilate without exceeding the applicable water quality standard. The TMDL allocates the total allowable pollutant load to wasteload allocations (WLAs) for point sources regulated by the National Pollutant Discharge Elimination System (NPDES) program and to load allocations (LAs) for all other sources. The WLAs and LAs in the TMDL provide a basis for states to limit the amount of pollution from both point and nonpoint sources to restore or protect a waterbody from exceeding the applicable water quality standard. This TMDL will provide the maximum average annual load of mercury that can enter the listed segment of the Etowah River without exceeding the applicable water quality standard. An allocation of the maximum annual load will be provided for both point sources and nonpoint sources. Because of the significant uncertainties associated with attaining reduction in the nonpoint source loading of mercury, which is primarily from atmospheric deposition, and due to the persistent bioaccumlative nature of mercury, this TMDL will propose that current NPDES permitted discharges be held at their current loading of mercury.

2. Problem Definition

The listed segment of the Etowah River is on the State of Georgia's 2002 Section 303(d) list. This segment of the Etowah River was listed because mercury in the tissue of Blacktail Redhorse exceeded Fish Consumption Guidelines (FCG) established by the State of Georgia (GADNR, 2000). The Fish Consumption Guidelines establish limits on the amount of fish that should be consumed over a given time frame (a week or a month) in order to protect human health.

The Georgia Department of Natural Resources (GADNR) uses a risk-based approach to determine how often contaminated fish may be consumed at different levels of fish tissue contamination assuming a consumption rate of approximately 32.5 grams of fish per day. Table 1 provides the recommended frequency of fish consumption for three different levels of contamination with mercury.

Table 1 Georgia Department of Natural Resources Fish Consumption Guidelines.

Mercury Fish Tissue Threshold (mg/kg)	Frequency of Consumption
0.23	Once a Week
0.70	Once a Month
2.3	Do Not Eat

If fish tissue contains 0.23 mg/kg (parts per million) or more of mercury, the State's FCG indicates that the fish should not be consumed more than once a week. If fish tissue contains 0.70 mg/kg (parts per million) or more of mercury, the State's FCG indicates the fish should not be consumed more than once per month, and if the fish tissue contains 2.30 mg/kg (parts per million) or greater of mercury, the State issues a "Do Not Eat" guideline. The FCG in place for the Etowah River is that Blacktail Redhorse should not be consumed more than once a week.

The methodology used by the State of Georgia in the development of the fish consumption guidelines targets specific species and size of fish, and uses a conservative risked-based approach in determining whether consumption guidance is warranted for a particular waterbody. EPA supports the State of Georgia's approach to establishing consumption guidelines as an appropriate way to inform the public of the potential risks in eating certain size and species of fish.

3. Applicable Water Quality Standard

TMDLs are established at levels necessary to attain and maintain the applicable narrative and numeric water quality standards. (See 40 CFR Section 130.7(c)(1)). The State of Georgia's Rules and Regulations for Water Quality Control do not include a numeric criterion for the protection of human health from methylmercury. Instead, the State's regulations provide a

narrative water quality standard, which establishes that waters are to be free from toxics. Since mercury may cause toxicity in humans, a numeric "interpretation" of the narrative water quality standard is necessary to assure that a TMDL will protect human health. EPA defers to the State water quality standard or criterion as the applicable water quality standard for development of TMDLs. States may establish (or interpret) their applicable water quality standards for protection of human health at a numeric concentration different from their fish consumption guidelines. The State of Georgia has made a numeric interpretation of their narrative water quality standard for toxic substances at a numeric concentration of no more than 0.3 mg/kg methylmercury in fish tissue. (See the July 30, 2001 letter from the Environmental Protection Division of the Georgia Department of Natural Resources (GADNR- EPD) to USEPA Region 4 RE: Interim Mercury Criterion.) This numeric interpretation protects the "general population", which is the population that consumes 17.5 grams per day or less of freshwater fish. This approach is consistent with EPA's recently adopted guidance value for the protection of human health from methylmercury described in the document entitled, "Water Quality Criterion for the Protection of Human Health: Methylmercury" (EPA, 2001). Using this methodology, which assumes that the general population is consuming 17.5 grams of fish per day, the waterbody is determined to be impaired and will be included on future State Section 303(d) lists when the weighted fish consumption concentration is greater than 0.3 mg/kg methylmercury. The methodology uses a "weighted consumption" approach that assumes 10.2 grams per day (58.4%) of the total fish consumption is trophic level 3 fish (e.g., catfish and sunfish), and 7.3 grams per day (41.6%) are trophic level 4 fish (e.g., bass). See Equation 3-1 below.

Equation 3-1 Calculation of Weighted Fish Tissue Concentration to Determine Impairment

$$Weighted\ Fish\ Tissue\ Concentration = (Avg\ Trophic\ 4\ Conc.* 41.6\%) + (Avg\ Trophic\ 3* 58.4\%)$$

where:

Avg. Trophic 4 Concentration (mercury in fish tissue) = 0.41 mg/kg

Avg. Trophic Level 3 Concentration (mercury in fish tissue) = 0.17 mg/kg

In July 2002, EPA sampled 2 locations in the listed segment of the Etowah River to collect site-specific data on ambient mercury in fish tissue and in the water. Using Equation 3-1, the site-specific fish tissue concentration data collected in the Etowah River yields a weighted fish tissue concentration of 0.27 mg/kg which is less than the State's current, applicable water quality criterion of 0.3 mg/kg.

4. TMDL Target

In order to establish the TMDL, the maximum allowable concentration of total mercury in the ambient water that will prevent accumulation of methylmercury in fish tissue greater than the applicable water quality standard of 0.3 mg/kg level must be determined. To determine this

allowable ambient water concentration, EPA referred to the "Revisions to the Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health" (also referred to as the "Human Health Methodology"; USEPA, 2000). The methodology is expressed below (Equation 4-1):

Equation 4-1 Calculation of the Water Quality Target

$$WQT = \frac{((ReferenceDose - RSC) * BodyWeight * UnitsConversion)}{(ConsumptionRate * Weighted\ BAF * FractionMeHg)}$$

where:

WQT = target water quality concentration of total Mercury in ng/l
Reference Dose = 0.0001 mg/kg/day Methylmercury (MeHg)
RSC = 0.000027mg/kg/day MeHg (Relative Source Contribution from Saltwater Species)
Body Weight = 70 kg
Units Conversion = 1.0E6
Consumption Rate = 0.0175 kg/day Fish
Weighted Bioaccumulation Factor = 2,167,569
Fraction of the Total Mercury as Methylmercury = 0.06 as measured

In the determination of the allowable ambient water concentration, EPA used the recommended national values from the Human Health Methodology, including the reference dose of 0.0001-mg/k/day methylmercury; a standard average adult body weight of 70 kg; and the consumption rate for the general population of 17.5 grams of fish per day. (Note that a recent report by the National Academy of Sciences confirms that methylmercury is a potent toxin, and concludes that EPA's reference dose of 0.0001 mg/kg/day is appropriate (National Research Council, 2000)). For the other factors in the calculation, bioaccumulation and fraction methylmercury, EPA used site-specific data from the listed segment of the Etowah River collected in July of 2002. (See Section 5.2.) From this site-specific data, EPA determined a representative "weighted" bioaccumulation factor (BAF). This BAF was calculated by taking the average calculated BAF from each of the two trophic levels to determine a "weighted" BAF based upon the different consumption rates for trophic levels, and a measured fraction methylmercury of 0.06. **Using this approach, an allowable concentration of total mercury in the ambient water (WQT) in the listed segment of the Etowah River for the protection of human health is 2.2 nanograms per liter (parts per trillion)**. This concentration or less in the ambient water will prevent the bioaccumulation of mercury in fish tissue above 0.3 mg/kg. The site-specific data for total mercury in the water column collected in July 2002 was 1.9 and 2.1 ng/l.

5. Background

The Etowah River is located in north/central Georgia (USGS Hydrologic Unit Code (HUC) 03150104). The Etowah River basin is presented in Figure 1.

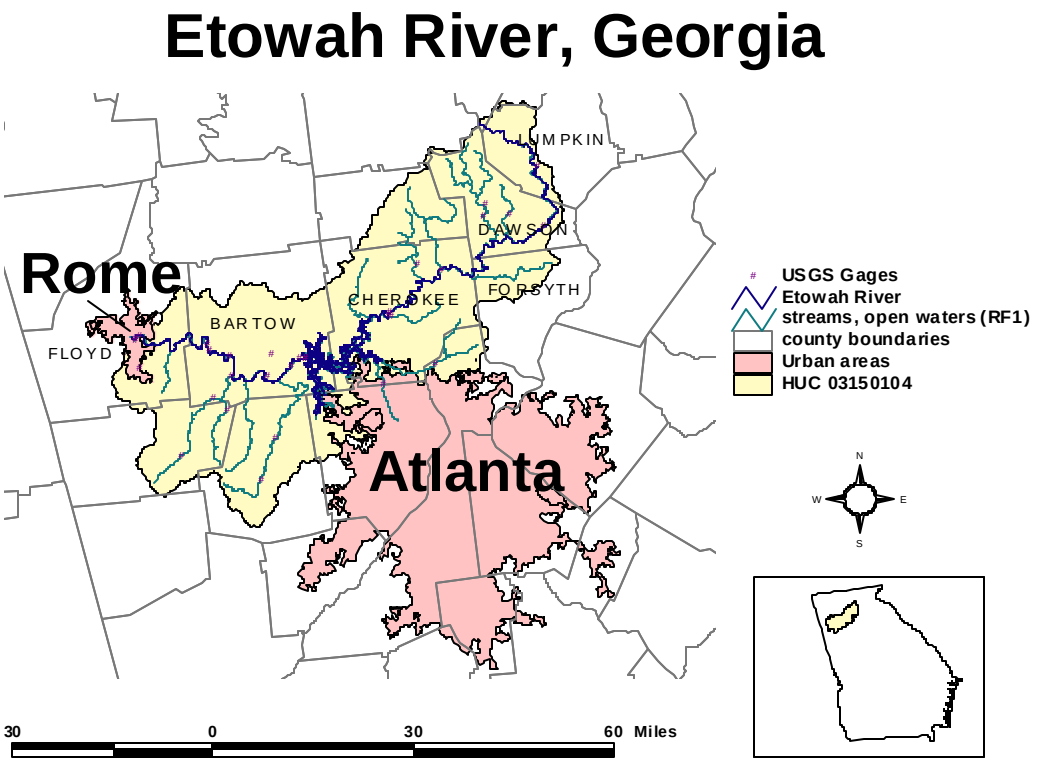

Figure 1 Map of the Etowah River basin in north/central Georgia.

5.1. Source Assessment

A TMDL evaluation examines the known potential sources of the pollutant in the watershed, including point sources, nonpoint sources, and background levels. There are no NPDES permitted facilities that discharge to the listed segment of the Etowah River. Although there are historical gold mines in the watershed, these mines do not appear to be significant sources of mercury. The primary nonpoint source of mercury is atmospheric deposition.

5.2. Available Monitoring Data

EPA Region 4 sampled the listed segment of the Etowah River in July of 2002. Since even low concentrations of mercury in water can lead to significant accumulation of mercury in fish tissue, EPA sampled the Etowah River using the most sensitive sampling and analytical techniques. The samples were collected using the "clean hands" method (USEPA, 2000 and 1996), and analyzed using the ultra-trace level analytical technique, EPA Methods 1630/1631 (USEPA, 1998 and 1999). EPA adopted this method in June of 1999 for mercury in water for data gathering and compliance monitoring under the Clean Water Act and Safe Drinking Water Act. This method can reliably measure mercury to 0.5 ng/l (parts per trillion).

The purpose of this data collection effort was to collect data needed for the development of this mercury TMDL. The locations for the water column samples are illustrated in Figure 2. Water column, fish, sediment and soil samples (taken adjacent to the water column samples outside the flood plain) were collected from 2 locations within the listed segment of the Etowah River. The sample locations, noted as ER1 (Below Clear Creek) and ER2 (Below Amicalola Creek), were used for this TMDL.

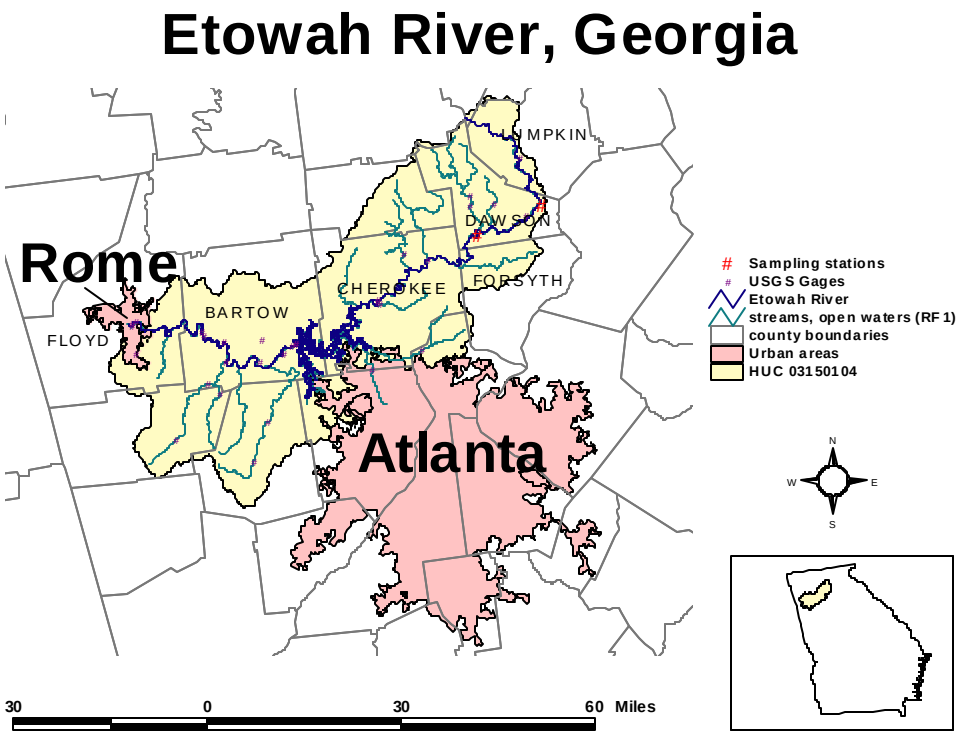

Figure 2 Locations of Etowah River Sampling Stations in Georgia.

The fish collection consisted of approximately 10 fish per sampling location, of which 5 were trophic level 3 fish (sunfish, black crappie, catfish) and 5 were considered trophic level 4 (bass, black crappie).

The following sections provide the results of the field sampling for mercury.

5.2.1. Water Column Data

Water column samples were collected to determine the ambient concentration of mercury in the water column using Method 1631, an ultra-trace level clean sampling and analytical technique with a quantification level of 0.5 ng/l. The water column samples were analyzed for both total mercury and methylmercury. Because methylmercury is the primary form of mercury taken up in the food chain, it was important to quantify the fraction of the total mercury present

in the methyl form. Table 2 provides the measured total and methyl mercury concentrations in the water column of the listed segment of the Etowah River.

Table 2 Water Column Mercury Concentrations in the Etowah River, Georgia, July 2002.

Station	Waterbody	Mercury, Total (THg, ng/L)	Mercury, Methyl (MeHg, ng/L)	Fraction MeHg
ER1	Etowah River	2.10	0.14	0.07
ER2	Etowah River	1.90	0.11	0.06

5.2.2. Fish Tissue Data

Samples of fish were taken from the listed segment of the Etowah River within the same area as the water column and sediment samples. Trophic level three (sunfish, catfish) and trophic level four fish (bass) were targeted in the collection because they represent the fish that are caught and kept by anglers and consumed as a source of food. The fish filets obtained during EPA's sampling effort were analyzed for total mercury (THg). Table 3 provides the individual fish data.

Table 3 Fish Tissue Mercury Data for the Etowah River, Georgia, July 2002.

Station	Waterbody	Trophic Level	Species	Total Length (mm)	Whole Wt (gm)	Filet Wt (gm)	THg, (mg/kg) Wet Weight
ER1	Etowah River	4	Spotted Bass	280	252	83	0.85
ER1	Etowah River	4	Redeye Bass	250	147	57	0.86
ER1	Etowah River	4	Redeye Bass	225	132	48	0.70
ER1	Etowah River	4	Redeye Bass	225	111	42	0.54
ER1	Etowah River	4	Shoal Bass	185	125	39	0.85
ER2	Etowah River	4	Black Crappie	240	162	69	0.13
ER2	Etowah River	4	Black Crappie	241	110	69	0.15
ER2	Etowah River	4	Redeye Bass	247	156	71	0.47
ER2	Etowah River	4	Redeye Bass	208	102	42	0.13
ER2	Etowah River	4	Redeye Bass	225	130	58	0.46
ER1	Etowah River	3	Black Crappie	255	194	69	0.10
ER1	Etowah River	3	Black Crappie	245	214	86	0.20
ER1	Etowah River	3	Redbreast Sunfish	170	99	29	0.70
ER1	Etowah River	3	Redbreast Sunfish	145	52	17	0.52
ER1	Etowah River	3	Bluegill Sunfish	145	73	28	0.09
ER2	Etowah River	3	Redbreast Sunfish	180	102	42	0.07
ER2	Etowah River	3	Bluegill Sunfish	192	130	47	0.15
ER2	Etowah River	3	Bluegill Sunfish	168	87	36	0.06

ER2	Etowah River	3	Channel Catfish	502	1266	529	0.22
ER2	Etowah River	3	Channel Catfish	395	478	173	0.28

Table 4 shows the weighted fish tissue concentration calculated by applying Equation 3-1 to the July 2002 data. A weighted fish tissue concentration exceeding 0.3 mg/kg would indicate impairment.

Table 4 Weighted Average Fish Tissue Concentration in the Etowah River, Georgia, July 2002.

Trophic Level	Avg. Conc. Total Hg mg/kg	Max. Conc. Total Hg mg/kg	Min. Conc. Total Hg mg/kg	Count	Length	Total Hg mg/kg Geomean
4	0.5	0.9	0.1	10	233	0.4
3	0.2	0.7	0.1	10	240	0.2

Applying Equation 3-1 to the trophic level geometric mean concentrations yields a weighted average fish tissue concentration of 0.27 mg/kg.

6. Total Maximum Daily Load (TMDL)

The TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard (as calculated in Section 3). The TMDL for the listed segment of the Etowah River is 0.5 kg/year to protect against significant accumulation of mercury in fish tissue. This TMDL determines the maximum load of total mercury that can enter the Etowah River within a year without exceeding 0.3 mg/kg in fish tissue residue as calculated in Section 3.

6.1. Critical Condition Determination

The annual average flow and annual average loading represent the critical conditions for this TMDL. Annual average flow and annual average loading are appropriate for several reasons. First, EPA's Human Health methodology, which has been used to derive an appropriate numeric interpretation of Georgia's narrative water quality standard for toxic substances for this TMDL, assumes that health effects due to mercury occur as a result of long-term exposure to mercury in fish tissue through consumption of contaminated fish. The bioaccumulation of methylmercury in fish tissue is a long-term, multi-year, process. The State applies their human health criteria at a flow equivalent to the annual average flow (Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03(5)(e)(iv) which requires the application of annual average load in the TMDL.

6.2. Seasonal Variation

Mercury is expected to fluctuate based on the amount and distribution of rainfall, and on variable emissions from local and distant atmospheric sources. Since wet deposition is greatest in the spring and winter seasons, loadings of mercury are highest during these times of the year.

However, these seasonal impacts or other short-term variability in loadings are damped out by the biotic response of bioaccumulation, which as discussed above, is a long-term process. Therefore, seasonal variations are not important in this TMDL, since the load is expressed on an average annual basis.

6.3. Margin of Safety

A Margin of Safety (MOS) is a required component of a TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody. The MOS may be expressed in conservative assumptions used to develop the TMDL. A MOS is incorporated into this TMDL in that the maximum load is based upon a conservative representation of mercury entering the Etowah River and the TMDL calculation does not take into account reduction/volatilization. In addition, that increment of mercury loading between the current annual loading and the total amount of mercury the River can receive without exceeding the water quality standard is reserved as an additional MOS. This MOS reflects EPA's recognition that mercury is a persistent, bioaccumulative pollutant that appears on EPA's list of priority toxic pollutants.

6.4. TMDL Determination

To determine the total maximum load of total mercury to the Etowah River, a conservative mass balance calculation is used. The annual average flow and the water quality standard calculated from Equation 4-1 is used to determine the maximum load of mercury to the waterbody that will not exceed a water column concentration of 2.2 ng/l.

Equation 6-1 TMDL Determination

$$TMDL = \frac{WQT(ng/l) * Annual\ Average\ Flow * Number\ of\ Seconds/Year * 1000}{Number\ of\ ng/g}$$

where:

Water Quality Target= 2.2 ng/l
Annual Average Flow in Waterbody = 7.6 cubic meters/second (as estimated from USGS flow gage 02389000, which is located on Etowah River between ER1 and ER2.)
Number of Seconds/Year = 31536000
Number of ng per gram = 1E9
The TMDL load is calculated as 0.5 kg/year total mercury.

7. Allocation of Loads

In a TMDL assessment, the total allowable load is divided and allocated to the various pollutant sources. This allocation is provided as a Load Allocation (LA) to the nonpoint sources and as a Wasteload Allocation (WLA) to the point-source facilities in Georgia with an NPDES permit.

The calculated allowable load of mercury that can come into the Etowah River without exceeding the applicable water quality standard of 2.2 ng/l is 0.5 kg/year. Because this assessment indicates that the allowable load can be maintained without reducing the current loads received by the River, both point and nonpoint sources will be assigned allocations equal to current loads. The remainder of the loading capacity is assigned to the MOS.

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